

A Mechanical Topper

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At our Denver meeting in 1940 some preliminary considerations in the design of an "in-place" topper were discussed. Three premises were established as a guide for future development work. The thickness of cut must be increased approximately 0.3 inch for each inch of increase in beet height. The net down-row component of the force necessary to sever the beet crown must not exceed a maximum of approximately 8 pounds per inch of beet diameter in the plane of cut. The gaging and cutting mechanism which is raised by the beet must be accelerated in its fall by a spring force equivalent to approximately 3 times the effective dynamic weight of the mechanism as referred to the finder.

Other features which were classed as desirable were the use of a narrow finder which could thread its way through heavy-top growth, and some method of maintaining the working parts in proper position with respect to original ground level, regardless of furrow depth or field irregularities. Two years of field experience has demonstrated that whereas certain of these features are unnecessary under some field conditions, all are essential to a machine with a wide range of adaptability.

Development of Topping Unit

A topping unit was displayed at our Denver meeting which represented our first effort to apply some of these basic principles in the design of a field machine. It was functionally incomplete and difficult to construct. Top disposal had not yet been considered, and no means had been provided to prevent the working parts from rising and falling with variations in furrow depth.

Clogging of the shoe-type finder with leaves and trash could be prevented only by the use of leaf-conveyor chains which complicated construction. High, loosely held beets were frequently pushed over by the finder. An oscillating knife prevented beet breakage, but necessitated light and expensive construction and was subject to clogging by wet leaf streamers and weeds.

Recent Progress

During the past 2 years many of these faults have been corrected and progress toward solution of the remaining problems has been consistent. A simple leaf-pickup device has been developed which consists of 2 oppositely rotating drums equipped with spring fingers.

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Its action is independent of beet size or of quantity of foliage and its power consumption is low. It is also effective in sweeping leaf streamers and weeds from the topping knife.

Erratic topping due to variations in furrow depth, irrigation dams, ditches, etc., has been eliminated by so mounting the topping unit as to permit freedom of movement in a vertical direction with respect to the frame or tractor to which it is attached. The unit rides on 2 shoes which slide along the ground immediately adjacent to the beet row. Since this ground is seldom disturbed by irrigation water, it provides a satisfactory datum from which to locate the topping mechanism.

Many of the difficulties with the gaging and cutting mechanism were eliminated by a basic change in cutting principle. The narrow finder was retained because of its obvious advantages in heavy top growth, but it was equipped with a driven track along its leading and lower edges. This type of construction has 3 outstanding advantages over the shoe finder. It is self-cleaning and eliminates the troublesome leaf-conveyor chains. Because of its climbing action, its tendency to push over beets is reduced to a minimum. Last, and most important, it eliminates the need for an oscillating knife, rotating disc, or other complicated cutting device. By applying a force to the beet crown in opposition to that generated by the cutting action, the net down-row thrust is reduced to the point where no breakage occurs.

The original fabricated framework of the unit has been abandoned in favor of cast construction. This has permitted better streamlining and has eliminated supports and braces which had contributed to the tendency of the machine to clog. All gearing and many of the other running parts are housed within the castings where they may be readily lubricated and protected from dirt.

A system of coulters, jointers, and lifting points reduces the quantity of dead-leaf streamers and weeds which pass through the machine, and so orient the remainder that it is more readily shed by the knife. This feature is necessary in wet fields and of value under all conditions.

Summary

In reviewing the progress of our work, it is convenient to enumerate the features in this topper which we believe to be unique:

The narrow, self-centering, track-type finder.

The principle of so mounting the unit as to cause it to operate at a fixed distance above the level of the ground immediately adjacent to the row.

The leaf-pickup device which combines the functions of top removal and knife cleaning.

The use of a finder which may fall independently of the topping knife and thus support the beet crown until the cut is completed.

The principle of tilting the knife at ground level to permit its rapid penetration of hard ground.

The use of a steering indicator which enables the operator to follow a row which is obscured by heavy top growth.

No future change in the operating principles of any of the parts is envisioned, but mechanical development and refinement of many of them is necessary. Some of the improvements which must be made before the machine will be useful for field work are:

Re-design of the finder track mechanism to permit longer periods of operation without fouling from dirt and other foreign material.

Development of a knife which either will be self-sharpening or will maintain a cutting edge for longer periods.

Determination of the rate of wear of the various components and re-design for satisfactory life.

Better streamlining of the trash-lifting points and the use of stiffer fingers in the leaf-pickup device to reduce the tendency of the knife to clog under wet, trashy conditions.

The machine in its present state is functionally satisfactory under most of the field conditions in the various beet-growing areas. Its flexibility is perhaps the greatest point in its favor. It is not, however, developed to the point where it would be practical for continuous use in farming operations,